

# Association Registries as Population Estimates

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THE BASIC PREREQUISITE to any epidemiologic study is an accurate picture of the population at risk. This may be accomplished by a complete enumeration or by selecting a sample population. A sample may be selected by any means if one is willing to accept limitations on the population about which one wishes to make inferences. At worst, a sample is representative only of itself. In addition, the collection, processing, and interpretation of information may be so poor that the data do not even reflect the sample. At best, a sample allows one to efficiently estimate, with known precision, one or more characteristics about a larger population. Between these extremes, the investigator compromises his sample, attempting to obtain a happy balance between cost and precision while recognizing biases in the methodology and providing a suitable caveat.

Scientists working with a group which has a common focus, such as occupation, commonly resort to rosters or registers to determine their study group. This approach is effective when registration provides incentives such as payroll, but the technique is questionable when registration is voluntary and noncompensatory. It is necessary to identify any biases in the sampling frame to determine its usefulness and as a guide to interpreting results.

In this report we describe a comparison between the Illinois veterinarians listed in the 1968 American Veterinary Medical Association (AVMA) Directory and those found during a

concerted attempt to construct the total veterinary population of the State.

## Materials and Methods

The population was reconstructed by cross-checking records for the period 1950-67 of the American Veterinary Medical Association, Illinois State Veterinary Medical Association, Illinois Department of Agriculture, Illinois Department of Registration and Education, and the University of Illinois, College of Veterinary Medicine. A master list, or roster, was compiled and then amended by searching veterinary journals for news notes concerning veterinarians entering and leaving the State. All military veterinarians, those for whom obituaries appeared in State or national journals, and those for whom death certificates were filed with the Illinois Department of Public Health, were taken off the roster.

The final roster was verified in 1967 and again in 1968 by personal visits or telephone calls by members of the Auxiliary to the Illinois State Veterinary Medical Association or employees of the Illinois Department of Public Health. Interviewers were also instructed to search for veterinarians in their area who were not on the roster.

The verified roster then was cross-checked with the Illinois listing in the 1968 AVMA directory. This procedure provided three groups: total roster, nonroster (not on the roster but in the 1968 directory), and nondirectory (on the roster but not in the 1968 directory). Characteristics of the veterinarians in the three groups were compared (1).

## Results

There were 1,186 nonmilitary veterinarians on the total roster compared with 1,095, including military veterinarians, in the 1968 AVMA directory. A total of 126 (10.6 percent) were on the roster but not in the directory, while 16 (1.5 percent) of the 1,095 listed in the directory were not on the roster.

There were 38 others who were listed incorrectly in the directory as Illinois veterinarians. Twenty-three of these had moved out of Illinois

before the 1967 interviews, including one who had moved to Ethiopia in 1965. Three were not veterinarians although they were associated closely with the profession, two as PhD faculty members at the College of Veterinary Medicine and the third as an AVMA employee. Six were deceased, one in April 1966, two in October 1967, and three in January 1968.

The address for one veterinarian was in a town not listed in the Rand McNally Atlas of Illinois, and his name was not in the alphabetical listing of either the 1966 or 1970 AVMA directories.

The remaining five were not listed in their local telephone directories and were not known to other veterinarians in the area. Questionnaires mailed to these veterinarians were returned marked "address unknown."

The nonroster group included three women and six graduates of European universities (table 1). There were 14 AVMA members, plus one dues-exempt member and one nonmember. The practice types were as follows: five teaching, four government, three commercial, and one each general

practice, toxicology, retired, and unknown. The year of graduation varied from 1906 to 1966, with a mode of 1964 and a median between 1956 and 1961.

The total roster and nondirectory groups had similar veteran status, height, weight, number of children, days lost due to accidents and illness, smoking history, number of years at present location, number of practice locations, and previous practice type for those who had retired.

The mean year of birth for the nondirectory group was 1913 compared with 1923 for the total roster group. This strong difference was further evidenced by the fact that 11 percent (14) of the nondirectory group were under 35 years of age compared with 26 percent for the roster group, and 35 percent (44) were 65 years, or older compared with 12 percent for the roster group. As expected, the mean year of graduation also differed markedly, 1931 compared with 1949.

There was a decided tendency toward specialties other than private practice in the nondirectory group (table 1); 49 percent were not in private

**Table 1. Population characteristics of veterinarians omitted from the 1968 AVMA directory compared with characteristics of those on the total Illinois veterinary roster**

Characteristic	Nondirectory			Nonroster			Roster		
	Number <sup>1</sup>	Per-cent	Total number <sup>2</sup>	Number <sup>1</sup>	Per-cent	Total number <sup>2</sup>	Number <sup>1</sup>	Per-cent	Total number <sup>2</sup>
Under 35 years of age.....	14	11	126	(3)	(3)	(3)	311	26	1,184
65 years of age or older.....	44	35	126	(3)	(3)	(3)	137	12	1,184
Female.....	3	2	126	(3)	19	16	31	3	1,186
Married.....	114	90	126	(3)	(3)	(3)	1,029	91	1,129
Divorced.....	2	2	126	(3)	(3)	(3)	10	1	1,129
Widowed.....	7	6	126	(3)	(3)	(3)	28	2	1,129
Never married.....	3	2	126	(3)	(3)	(3)	62	5	1,129
Other degrees.....	40	32	126	(3)	(3)	(3)	556	48	1,165
Practice type:									
Private:									
Large.....	31	25	125	0	0	16	337	28	1,185
General.....	13	10	125	1	6	16	103	9	1,185
Small.....	20	16	125	0	0	16	398	34	1,185
Government.....	27	22	125	4	25	16	144	12	1,185
Retired.....	26	21	125	1	6	16	83	7	1,185
Teaching.....	0	0	125	5	31	16	49	4	1,185
Research.....	3	2	125	0	0	16	15	1	1,185
Commercial.....	2	2	125	3	19	16	19	2	1,185
Other.....	3	2	125	2	13	16	37	3	1,185
College:									
Illinois.....	23	23	98	2	13	15	220	25	873
Inactive U.S.....	32	33	98	1	7	15	116	13	873
Other U.S.....	35	36	98	6	40	15	467	53	873
Canada.....	5	5	98	0	0	15	47	5	873
Other nations.....	3	3	98	6	40	15	23	3	873

<sup>1</sup> Number of veterinarians with known characteristic.

<sup>2</sup> Number of veterinarians of known status.

<sup>3</sup> Unknown.

NOTE: Mean birthday for nondirectory group is 1913; for nonroster group, unknown; for roster group, 1923. Mean graduation for the nondirectory group is 1939; for nonroster group, unknown; for roster group, 1949.

**Table 2. Health characteristics of veterinarians omitted from the 1968 AVMA directory compared with characteristics of those on the total Illinois veterinary roster**

Characteristic	Nondirectory			Roster		
	Number <sup>1</sup>	Percent	Total number <sup>2</sup>	Number <sup>1</sup>	Percent	Total number <sup>2</sup>
Job-related accidents . . . . .	13	10	126	105	8	1,301
Last physician consultation:						
18 months . . . . .	77	63	122	880	77	1,146
5 years or more . . . . .	21	17	122	81	7	1,146
Infections:						
Brucellosis . . . . .	30	24	126	224	17	1,301
Erysipeloid . . . . .	7	6	126	37	3	1,298
Leptospirosis . . . . .	1	1	126	19	1	1,301
Psittacosis . . . . .	0	0	126	37	3	1,301
Animal bites . . . . .	5	4	126	72	6	1,165
Rabies vaccination:						
Preexposure . . . . .	16	13	126	299	26	1,163
Post exposure . . . . .	34	27	1 6	225	19	1,163
Hypertension . . . . .	13	10	126	77	6	1,186
Diabetes . . . . .	6	5	126	28	2	1,186
Arthritis . . . . .	20	16	126	128	11	1,186
Heart disease other than rheumatic, congenital, or murmur . . . . .	8	6	126	49	4	1,186

<sup>1</sup> Number of veterinarians with known characteristic.  
<sup>2</sup> Number of veterinarians of known status.

practice compared with 29 percent for the total roster. They differed somewhat in marital status, and fewer had college degrees other than Doctor of Veterinary Medicine. Physician consultation was less recent in the nondirectory group. There were fewer with pre-exposure rabies immunization but more with post-exposure vaccination. They had slightly higher rates for job-related accidents, brucellosis, erysipeloid, hypertension, diabetes, arthritis and selected forms of heart disease (table 2). Their rates were lower for leptospirosis, psittacosis and animal bite.

**Discussion and Conclusion**

Despite the time and effort expended in developing and maintaining an accurate roster of veterinarians, 16 veterinarians were in the 1968 AVMA directory who had not been on the roster. Although these 16 persons represented only 1.3 percent of the roster, they were a far different group than those on the roster in every factor available for comparison.

On the other hand, 3.4 percent of the directory listings were incorrect, if we assume that the five who could not be located were not in Illinois at the time of the health study. Inclusion of the five men who died in October 1967 or later was unavoidable because of the October 16 cutoff date for the directory. These five were correctly part of the roster group in July 1967.

Probably the most important deficit was the 10.6 percent of the total roster group missing from the directory. This would be of little importance if this missing group were similar to the total veterinary population, but evidence presented here strongly suggests that the omitted group is older, less likely to be in private practice, and differs in many other characteristics which have been demonstrated to be related to age (1).

The variety of differences disclosed here illustrates the fallacy of conducting studies based on the veterinary population listed in the AVMA directories. Most other professional registries would probably have similar disadvantages.

The AVMA has recognized the problem and attempts to inform the reader through the following statement in the foreword of the 1968 directory:

**IMPORTANT:** The following statistics are not intended to reflect total veterinary population in the United States or any other country. The total number of veterinarians listed consists of all AVMA members and those non-member veterinarians who responded to the 1968 DIRECTORY verification survey by October 16, 1967.

It is hoped that this report will help scientists understand the reasons behind the warning.

**REFERENCE**

(1) Schnurrenberger, P. R., Martin, R. J., and Walker, J. F.: Characteristics of veterinarians in Illinois. JAVMA 160: 1512-1521, June 1, 1972.